

# Best Practices for Road Weather Management

## Tennessee Low Visibility Warning System

On December 11, 1990 the visibility distance on a segment of Interstate 75 in southeastern Tennessee was less than 10 feet (3.1 meters). Extremely low visibility contributed to chain-reaction collisions in northbound and southbound lanes involving 99 vehicles, 42 injuries, and 12 fatalities. This crash prompted the design and implementation of a low visibility warning system on the interstate freeway. The system covers 19 miles (30.6 kilometers) including a three-mile (five-kilometer), fog-prone section above the Hiwassee River and eight-mile (13-kilometer) road sections on each side of the river.

**System Components:** Managers with the Tennessee Department of Transportation (DOT) and the Tennessee Department of Safety access a central computer system that collects data from two Environmental Sensor Stations, eight forward-scatter visibility sensors, and 44 vehicle detectors. Underground fiber optic cables transmit sensor data from the roadway to an on-site computer for processing. Data from the on-site computer is relayed via a microwave communication system to the central computer in the Highway Patrol office in Tiftonia. Traffic and emergency managers employ both advisory and control strategies. Motorists are notified of prevailing conditions via flashing beacons atop six static signs, two Highway Advisory Radio (HAR) transmitters, and ten Dynamic Message Signs (DMS). Roadside delineator posts with highly reflective stripping are spaced roughly 80 feet (24.4 meters) apart throughout the project area for visual observation of visibility conditions. Speed management is accomplished by controlling ten Variable Speed Limit (VSL) signs. When necessary, access to the affected highway section is restricted with eight gates located on interchange ramps.



VSL Sign

**System Operations:** By continually monitoring sensor data, the on-site computer predicts and detects conditions conducive to fog formation and detects significant reductions in traffic speed. The central computer sounds an audible alarm in the Highway Patrol office when established threshold criteria are met. When alerted dispatchers post a reduced speed message on DMS and notify Highway Patrol troopers. Troopers are stationed in the project area from 5 AM to 10 AM when most fog events occur. Within five minutes of an alarm troopers verify conditions by counting the number of visible delineator posts.

Control software provides decision support by correlating field sensor data with pre-determined response scenarios. When troopers confirm low visibility conditions, managers select pre-programmed DMS messages (see table below), pre-recorded HAR messages, and appropriate speed limits based upon scenarios proposed by the central computer. The system also allows the display or broadcasting of customized messages. The speed limit is reduced from 65 to 50 mph (105.4 to 80.4 kph) when visibility is between 480 and 1,320 feet (146.3 and 402.3 meters). The limit is lowered to 35 mph (56.3 kph) for visibility distances between 240 and 480 feet.



Ramp Gate

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Under the worst-case scenario—visibility less than 240 feet or 73.2 meters—Highway Patrol troopers activate automatic ramp gates to close the interstate and detour traffic to US Highway 11. Low visibility has caused freeway closures twice since the warning system was deployed; once due to fog and once due to smoke from a nearby fire.

**Tennessee Low Visibility Warning System Messages**

Conditions	Displayed Messages
Reduced Speed Detected	"CAUTION" alternating with "SLOW TRAFFIC AHEAD"
Fog Detected *	"CAUTION" alternating with "FOG AHEAD TURN ON LOW BEAMS"
Speed Limit Reduced **	"FOG AHEAD" alternating with "ADVISORY RADIO TUNE TO XXXX AM"
	"FOG AHEAD" alternating with "REDUCE SPEED TURN ON LOW BEAMS"
	"FOG" alternating with "SPEED LIMIT XX MPH"
Roadway Closed ***	"DETOUR AHEAD" alternating with "REDUCE SPEED MERGE RIGHT"
	"I-75 CLOSED" alternating with "DETOUR →"
	"FOG AHEAD" alternating with "ADVISORY RADIO TUNE TO XXXX AM"

\* "FOG" is displayed on VSL signs. \*\* "FOG" and reduced speed limits are displayed on VSL signs, and HAR messages are broadcast. \*\*\* "FOG" is displayed on VSL signs, HAR messages are broadcast, and ramp gates are closed.

**Transportation Outcome:** The low visibility warning system is activated about once a week, primarily from October to March. Ninety-five percent of system activations result in a speed limit reduction to 50 mph. There have been over 200 crashes, 130 injuries and 18 fatalities on this highway section since the interstate opened in 1973. Safety has significantly improved after deployment of the warning system in 1994, as only one fog-related accident has occurred.

**Implementation Issues:** When planning the Interstate 75 system, traffic managers assessed another low visibility warning system in Charleston, South Carolina. Device technologies, system components, and operational procedures were evaluated to assist Tennessee managers with system design. After developing requirements for equipment, communications, and power supply DOT managers determined system scope (i.e., coverage of the most fog-prone area), field equipment locations, and warning messages. To ensure system reliability, backup radio and telephone communication systems, as well as an emergency power system were installed.

Some system integration problems were experienced during implementation. There were minor complications associated with hardware failures due to the harsh outdoor environment. Traffic managers have been unable to observe system status or receive alerts due to trouble with data transmission from the project site to the regional DOT office.

System designers addressed system maintenance and expandability. Both routine and emergency maintenance are performed regularly on system components. The system was planned to accommodate future integration of new technologies or components, including a digital Closed Circuit Television surveillance system.

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